



Published in final edited form as:

Lancet Oncol. 2018 February ; 19(2): e113–e122. doi:10.1016/S1470-2045(18)30003-2.

Population-based cancer screening programmes in low-income and middle-income countries: regional consultation of the International Cancer Screening Network in India

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Abstract

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SS led the writing and coordinated feedback from all authors. GM, GKR, and RM led the discussions from the Government of India, provided contextual information about India, and discussed plans for implementation of cancer screening in India that informed the discussions, as well as the minimal elements for cancer screening outlined in this manuscript. EL, MB, NS, RS, PR, and ET helped review the outline, provided references, and critiqued early drafts of the paper. They also provided specific feedback on screening implementation that shaped the recommendations and figures presented in the paper. AN helped write the sections that report on cervical cancer screening in Bangladesh, provided references, and reviewed the paper. ST and DP helped with writing and review. MS provided feedback on early drafts and figures, and suggested references based on the US National Breast and Cervical Cancer screening programme.

Declaration of interests

We declare no competing interests. SS, DP, PR, ST, ET, and MS are employees of the US National Institutes of Health (NIH) or US Centers for Disease Control and Prevention. GM, GKR, and RM are employees of the Government of India. RS was a principal investigator for an NIH grant during the Agartala meeting, and when the paper was submitted and revised.

The reductions in cancer morbidity and mortality afforded by population-based cancer screening programmes have led many low-income and middle-income countries to consider the implementation of national screening programmes in the public sector. Screening at the population level, when planned and organised, can greatly benefit the population, whilst disorganised screening can increase costs and reduce benefits. The International Cancer Screening Network (ICSN) was created to share lessons, experience, and evidence regarding cancer screening in countries with organised screening programmes. Organised screening programmes provide screening to an identifiable target population and use multidisciplinary delivery teams, coordinated clinical oversight committees, and regular review by a multidisciplinary evaluation board to maximise benefit to the target population. In this Series paper, we report outcomes of the first regional consultation of the ICSN held in Agartala, India (Sept 5–7, 2016), which included discussions from cancer screening programmes from Denmark, the Netherlands, USA, and Bangladesh. We outline six essential elements of population-based cancer screening programmes, and share recommendations from the meeting that policy makers might want to consider before implementation.

Introduction

The burden of cancer is increasing in low-income and middle-income countries (LMICs), where an estimated two-thirds (65%) of the 8 million cancer-related deaths worldwide occur every year.¹ This increase is largely attributable to a multitude of factors including an ageing population, increased life expectancy, a high prevalence of modifiable risk factors (eg, tobacco use), poorly integrated primary and secondary prevention programmes, and inefficient or inaccessible treatment delivery systems.² Global estimates also indicate that these countries will bear a greater proportion of cancer incidence and mortality than high-income countries in the coming decades,² given that most of the world's population now lives in LMICs. This large projection in cancer burden is of concern to policy makers and researchers who advocate for increased momentum in global cancer control efforts, including translation of research evidence into meaningful programmes that benefit public health. A concern of cancer control in LMICs is the large proportion of cancers diagnosed at advanced stage, which often results in a combination of increased morbidity, poor options for survival, and drainage of economic resources of the affected family.³ Cancer prevention and early detection through screening are thus important goals for programmes and governments worldwide. The appeal of reductions in cancer morbidity and mortality that these programmes provide has led many LMICs to consider screening as a cancer control strategy. In 2017, WHO member states adopted the draft resolution,⁴ which underscores cancer control as a national public health priority, with specific emphasis on screening and assessment of screening programmes.

As policy makers consider early detection through screening, they must consider the multilevel context within which organised screening programmes are implemented.⁵ This context includes an individual's heterogeneity with respect to education, attitudes, understanding of screening, and patterns of care seeking; provider teams with variable commitment, technical expertise, and experience; regional diagnostic and treatment organisations that vary in their policies, staffing, and information systems infrastructure; and

communities that vary in cancer incidence, insurance reimbursement, and available cancer care.⁶ Furthermore, policy makers in these communities might face competing priorities for health-care expenditures as well as shifting political and economic situation in the nation as a whole. Consideration of the specific sociopolitical and health-care system context in which screening is implemented is therefore a complex process, and early consultation from established programmes is needed to alert policy makers to issues when adjustments in programme and policies are needed.

Two main approaches have been used within countries that have launched cancer screening programmes—organised or opportunistic screening.⁷ Both approaches involve the screening of asymptomatic individuals for cancer and are dependent on the structure and organisation of national health systems and service delivery. Organised screening programmes define a target population for screening and systematically invite all eligible members of the population to participate.⁸ Characterised by systems put in place to monitor and to assess screening participation, programme processes, and outcomes, organised screening programmes allow population-based provision of high-quality services and patient-focused follow-up and referral pathways. Organised programmes are typically administered centrally and include close programme monitoring and assessment by an oversight committee to achieve benchmarks of progress that correspond with screening trials. By contrast, opportunistic screening, also called case finding, involves a provider who offers screening tests to those who request them, or involves the individual accepting an offer from the provider. In opportunistic screening, neither a defined population nor systematic invitation of individuals is used and rarely includes systematic assessment, although overall screening rates might be ascertained through population-based or health facility-based surveys or records. Most countries either use organised screening (eg, the Netherlands, Denmark) or opportunistic screening (eg, USA),⁹ and in some countries, such as Switzerland, both approaches are seen.¹⁰

The International Cancer Screening Network (ICSN) was created to share lessons across various countries on the experiences learned in organised cancer screening programmes.¹¹ The ICSN is a voluntary consortium of countries with long-standing population-based cancer screening programmes that has made active efforts to assess and to improve the processes and outcomes from cancer screening in practice. These programmes are either national or subnational in range, and are either established or pilot-based. Originally coordinated by the Applied Research Programme of the US National Cancer Institute (NCI), the ICSN is now managed by the NCI Center for Global Health. The consortium began by focusing on breast cancer in 1988, involving representatives from 11 countries, and has since grown to cover 33 countries to discuss organisational aspects of breast, colon, and cervical cancer screening programmes.

An emerging activity of the ICSN includes sharing evidence and experiences from organised cancer screening programmes with countries that are beginning to launch their own initiatives. Such interactions can provide useful opportunities to hear about lessons learned from experienced countries, outline successful approaches, and present results from the organisation, implementation, and assessment of national and regional programmes of the ICSN. The first regional consultation of the ICSN was held in Agartala, the capital of the

state of Tripura in northeast India (Sept 5–7, 2016). This consultation coincided with the release of the operational guidelines of cancer screening launched by the Indian Government in August, 2016.^{12,13} Tripura is one of the smallest states in India, with 36 million people, and has a well organised public health system and tertiary cancer care centre, two key conditions for the successful implementation of population-based cancer screening programmes.¹⁴ The US NCI Center for Global Health and the Government of India have had several collaborative activities since 2012, including a joint national meeting on common cancers in September, 2013, during which a consensus on screening guidelines was developed and challenges in the implementation of these guidelines were identified and discussed.¹⁵ In this Series paper, we report the outcomes of the regional meeting of the ICSN, which further bolstered the engagement with India in cancer research cooperation. Participants at this meeting discussed the essential elements of a national cancer screening programme, which included organisation and assessment.

Six essential elements of national cancer screening programmes

Population-based cancer screening programmes have a broad goal of detecting cancer or a precursor lesion soon enough to enable early and cost-effective treatment, and improved survivorship and quality of life. National programmes develop screening initiatives on the basis of cancer burden. Irrespective of the cancer type being screened for, and the tools required for screening, a set of essential components that enable a population-based screening programme to serve the needs of the patient are needed to maintain high-quality standards of care, and sustain efficient practices.

The first essential component is the development of a clear policy for cancer screening (panel 1). Policy that will benefit cancer outcomes is based on considerations of populations affected by cancer, quantitative decisions on the age group to screen, and disease prevalence, as well as recruitment methods, screening intervals, screening methods, diagnostic tools, and algorithms and guidelines for screening.^{8,16} Additional policy elements include the establishment of governance structures and standards within the screening programme that will allow for monitoring and assessment, as well as research conduct within the screening programme. National surveys commissioned by the European Union, as well as evaluations and descriptions of organised screening programmes in the continent,^{17–19} endorse the role of defining implementation details for screening, which include adherence to quality assurance guidelines, client engagement, data protection, and registration and management of screening data.²⁰ Screening policy is also informed by the economic burden of cancer, national health spending, and health-care delivery systems. Analyses estimate that the cumulative lost productivity due to cancer in LMICs is US\$1.5 trillion.²¹ Many high-income countries have some form of universal health coverage or insurance to make cancer screening affordable. Several LMICs are also moving towards universal health coverage; however, systems of insurance and requirements for prepayment and out-of-pocket payments vary from country to country. In a multicountry analysis²² of health expenditures over two decades, ending in 2014, spending rates in LMICs increased more than high-income countries; however, on average 58% of spending in LMICs came from out of pocket expenses. Cancer is an expensive disease to detect and to treat, therefore policy making for

cancer screening programmes should consider economic factors in its design and implementation.

Panel 1

Policy elements to be decided before the initiation of a screening programme

- Area to be covered by screening activity
- Age group
- Recruitment method
- Screening method
- Screening provider
- Financing and insurance systems
- Screening interval
- Method for follow-up of abnormal findings
- Follow-up provider
- Payment for follow-up or treatment
- Data files to follow up individuals targeted by screening or alternative documentation methods
- Performance indicators
- Time interval for publication of performance indicators
- Quality indicators, process indicators, and access to diagnosis
- Access to treatment
- Trained human resources and facility infrastructure for screening

The second essential component is recognition of the fact that screening is a process and not simply a discrete event.⁵ Screening that benefits populations is part of a continuum of care. This continuum includes steps that a patient will take to consider and to attend screening and the steps that are taken by the provider and the health system to facilitate a complete care pathway. Crucial steps in the continuum include timely referral and further follow-up tests, referral to treatment if the screening test is positive, and processes that ensure follow-up and return for retesting if the test is negative. This continuum is influenced by factors that operate at the individual level, screening facility and health systems level, and community and national levels. Target population factors, such as awareness of cancer risk, knowledge about cancer detection, experience of stigma against cancer, and ability to pay for screening, can influence screening participation.²³ At the facility and health systems levels, staff training and the availability of equipment and expertise affect scheduling and the coordination of screening with the rest of care. At the community and national levels,

resources (eg, support groups) and policies (eg, recommended screening intervals and techniques, and financing for cancer screening) can affect screening implementation and adherence.²⁴ Because these factors can potentially influence outcomes and community wellbeing, their identification is important and they should be addressed before the launch of any national screening programme.

The third essential component is the development of a strong infrastructure for screening implementation. WHO defines health systems in part as “the people, institutions and resources, arranged together in accordance with established policies, to improve the health of the population they serve”.²⁵ For effective cancer screening, a strong health system has at least three essential building blocks: competent health personnel, organisational resources and capacity, and coordinated service delivery. Competent personnel for screening implementation include health and medical staff who will educate patients about screening, provide referral and treatment options, and engage with the patient being screened throughout the care pathway. Non-clinical staff are also included, such as screening programme managers or clinic managers and data systems experts. In LMICs, the lack of cancer screening experts has been addressed by training community health workers to administer screening tests or procedures and to provide referral to treatment.²⁶ Similarly, trained health educators or nurses can serve as non-medical patient navigators. These navigators play a key role in guiding patients through the screening process to ensure diagnosis and completion of treatment for those patients with cancer.²⁷ In addition to operational efficiency, community health workers and navigators are best positioned to understand the unique cultural context of the patient, which is an essential competency in any screening programme.²⁸ Screening programme managers are central to building and maintaining efficient programme implementation. Oncologists with excellent management experience in LMICs are needed to treat individuals diagnosed with the disease. Therefore, other competent individuals with management and coordination skills and the ability to interact with health providers are essential in any screening programme.

The work of personnel is facilitated by well functioning and readily available resources to enable screening (ie, equipment, utilities) and information systems (ie, computers, data management software, patient intake processes) to monitor the benefit of the screening programme. Experiences from high-income countries support the practice of creating multidisciplinary teams including personnel to manage and assess programmes.²⁹ Service delivery is a crucial component to effective screening and comprises coordination of the collection of screening samples, including timely analysis and reporting the establishment of referral pathways to treatment, and the development of capacity for treatment.²⁴

The fourth essential component for effective cancer screening is the establishment of monitoring and assessment systems (table). Key components of these systems include the development of minimal data elements and the establishment of standards for performance, quality, and data oversight. Minimal data elements for cancer screening refer to a basic set of indicators that can provide information about the progress and achievements of the screening programmes. Information about five indicators should be collected regardless of cancer type: size of the population at risk, proportion of the at-risk population that has been screened, the proportion of patients who test positive among those screened, proportion of patients

diagnosed with cancer among individuals who tested positive, and the proportion of patients with cancer who have been treated. In addition to the data elements needed to obtain these measures, population-based programmes should also agree on performance standards corresponding to these elements. Performance standards define the acceptable limits of minimum data elements that the programme will strive for. For instance, the US National Breast and Cervical Cancer Early Detection Program (NBCCDP) specified that 90% or more of patients with abnormal screening results will be followed up,³⁰ and the European Union has published screening goals for breast, colon, and cervical cancer.³¹ Performance standards allow for the improvement of screening delivery and development of monitoring, staffing, and operational standards within a programme.³²

Closely linked to performance and quality standards are considering and addressing contextual influences. These influences include the level of commitment between patients who will be screened and the providers and staff who are involved in the screening programme. They also include an understanding of the needs of patients and their families regarding cancer screening, the identification of barriers and facilitators to access screening, and the identification of key elements of operations (ie, diagnostic facilities and client transportation). Here, developing training and retraining to maintain staff competencies and education of patients are essential focus areas. Data standards include an understanding of issues such as health and laboratory information systems, information technology infrastructure, and human resources involved in the collection, storage, analysis, and review of the analysed data so that programme improvements can be implemented as needed.³³ These standards also encourage specific processes of feeding back screening test results to patients, providers, and facilities in a timely manner so that different tiers of the health system can integrate with services along the screening-to-treatment continuum. Estimates of cost per screening in the NBCCDP indicate that data management, quality improvement and assurance, and assessment constituted 9% of the overall cost.³⁴ Several frameworks are available to guide the development of management and assessment systems, questionnaires to collect data to monitor patient progress through the care continuum, and coding systems for data entry and analysis.^{33,35}

The fifth essential component is planning for community engagement. Awareness about cancer and the possibility of early detection remain low in LMICs.^{36,37} Screening programmes that have increased patient participation have done so with high-quality and periodic education programmes, and with campaigns tailored to the specific cultural context of a community,³⁸ which allows opportunities to engage with the community to gain feedback. Community engagement during the programme also highlights areas of improvement in screening education and screening procedures, including sample collection and scheduling.^{34,39} Ensuring that the supply of screening services and infrastructure are in place is key to address the demand for these services created from community engagement.

The last essential component to consider is implementation science research. Implementation science research seeks to understand strategies that bring scientific evidence to health delivery settings.⁴⁰ This inquiry can inform health providers, programme managers, and policy makers about the feasibility and adaptation of an intervention, identify quality improvement areas within a screening programme, and identify strategies to scale up

or disseminate to a larger coverage area. Evidence from randomised controlled trials to investigate a screening approach is generated in ideal and controlled conditions. Bringing this evidence to practical (real-life) settings requires further understanding of multilevel contextual factors that can influence screening processes and outcomes. These factors include inadequate human and financial resources for screening, uninterrupted financing of the programme, and poor adoption of a screening recommendation by providers.⁴¹ Many countries have launched pilot research and demonstration programmes to understand how screening can be delivered in their local settings with the human and financial resources that are available to them. The type of screening test to use and an understanding of the feasibility and acceptability of the test (eg, human papillomavirus DNA-based testing for the early detection of cervical cancer in El Salvador),⁴² sample collection methods, venue and processes for screening individuals, use of trained community health workers as navigators to help patients during the screening programme, and cost-effectiveness studies show how research might guide policy decisions.^{43,44} The value of this research is that it can help to identify context-specific and cultural-specific approaches to effective screening delivery.

Country-specific experiences

After a discussion of the six essential elements of national cancer screening programmes, participants in the ISCN regional meeting heard from representatives from different countries about the essential elements of their respective national programmes. In this section we summarise these discussions, using the experience of a national cervical cancer screening programme as an example and provide other examples of population-based cancer screening in other disease settings from other countries. We also summarise how India's operational guidelines align with the six essential elements of a national screening programme.

The country-specific discussions began with speakers from Denmark and the Netherlands. Both of these countries have an organised cancer screening programme and use a population register or census as a basis for screening recruitment. In Denmark, regional screening programmes started in 1987. All women aged 23–65 years are invited to be screened and the Pap smear is the main test used (or human papillomavirus DNA test for women > 60 years). Women aged 23–49 years are invited for screening every 3 years, whereas women aged 50–65 years are invited every 5 years. The Netherlands started their programme in 1976, and women aged 30–60 years are invited for a Pap smear every 5 years. In 2017, the human papillomavirus DNA test became the primary test for cervical cancer screening in the Netherlands. Both the Danish and the Dutch screening programmes started as pilot projects at the local level and were scaled up to be nationwide over the course of several years.^{45,46} Furthermore, monitoring and assessment of programmes in these and other countries has resulted in recommendations for improvements, such as better linkages to cancer registries, standardisation of data collection and reporting, and enhancement of provider training.⁴⁷ An important lesson is the use of personal identification numbers for all individuals to allow potential linkages between screening, treatment, and health registries or databases. Notably, screening programmes in many European countries operate in the context of some form of government-supported insurance or mandated health insurance programme, ranging from

free universal health coverage (eg, Denmark, Italy, UK) to mandatory insurance (the Netherlands), which facilitates affordability and access.

The USA and Bangladesh have opportunistic cancer screening programmes. The US Preventive Services Task Force, an independent volunteer body, provides recommendations for cancer screening on the basis of a review of the scientific evidence, which are then adopted nationally. Although the USA does not have an organised cancer screening programme, managed care organisations in the private sector have adopted systems to coordinate care. Furthermore, specific groups in the population might be targeted for screening, such as in the NBCCDP.⁴⁸ The NBCCDP is administered by the US Centers for Disease Control and Prevention, and provides free or low-cost screening to medically underserved women aged 21–64 years who are living below the poverty level, as identified through US census data. Since the programme began in 1991, more than 4.6 million women have been screened. This federally funded programme provides patients with information and access to clinics for screening and treatment, with no charges for services used.^{30,48}

Opportunistic screening for cervical cancer in Bangladesh began with a pilot programme in randomly selected districts in 2005, and slowly developed to include larger parts of the country.⁴⁹ All women older than 30 years were offered screening. Unlike in Europe, health providers in Bangladesh and other LMICs use acetic acid as the screening method of choice for visual inspection of the cervix because of cost and feasibility in line with WHO screening recommendations.⁴⁹ This pilot programme was extended during 2006–10 to include all districts within the country, and has expanded to the subdistrict level. Training protocols and screening implementation lessons from the pilot programme informed the expansion part of the programme. In 2008, an assessment of the pilot programme was done and noted areas of improvement including more efficient linkage to treatment, improved targeting efforts to reach eligible women, and the need for quality assurance standards.⁵⁰

Challenges and opportunities in global cancer screening

After data from the Netherlands, Denmark, USA, and Bangladesh were presented, participants at the ICSN meeting discussed lessons learned from their experiences in cancer screening. Five categories of lessons and opportunities were discussed: models that allow for affordability and access; models that use implementation research to inform screening policy; models that use existing platforms for care delivery to integrate cancer screening services; models that use community-based health workers; and models that have incorporated data oversight standards to understand quality of screening delivery and outcomes.

Models that allow for easy access and low cost are seen in countries with universal health care, such as Sri Lanka, Mexico, and Thailand.^{51–53} Free opportunistic screening is offered through government-supported health systems that allow access particularly to the rural and underserved populations. Although cancer screening and treatment costs are covered, challenges remain in these and other LMIC settings, such as accurate diagnosis and treatment completion.

El Salvador's experiences serve as an example of how researchers and policy makers can work together to develop guidelines for screening that will best serve a specific population. In this case, evidence about the feasibility, acceptability, and cost of human papillomavirus DNA-based cervical cancer screening was systematically generated to inform national decisions about cervical cancer control strategies.⁵⁴ Examples from sub-Saharan Africa, particularly Zambia, Tanzania, and Botswana, show that cancer screening (particularly cervical cancer screening) provided through existing programmes focused on infectious diseases and maternal and child health helps to reach individuals who have decided to seek care.⁵⁵ Although these approaches are opportunistic and might not reach all eligible women, the programmes use paramedical professionals (eg, community health workers) to triage cases, and have adopted approaches (eg, see and treat) that help to complete care in one visit, thus minimising the number of patients that are lost to follow-up.⁵⁶ Education about cancer prevention and interventions to help reduce stigma typically associated with screening in LMICs play a key role in reducing the fear around cancer, and promoting a community's recognition and acceptance of cancer prevention and care seeking. The experience with infectious disease control and a history of addressing stigmatised diseases, such as HIV, leprosy, and tuberculosis, facilitates the discussion of fear and stigma in ways that are appropriate to the local context.

In many LMICs, an important catalyst to screening access and treatment completion is the community health worker. The shortage of trained nurses and oncologists is well documented in these settings,⁵⁷ and evidence increasingly suggests that training of these workers to administer screening and facilitate referral to a tertiary care centre can downstage disease and potentially improve outcomes.⁵⁸ Data infrastructure facilitates understanding of efficiencies and improvement within screening. In countries with organised screening programmes, presence of a population register or a census allows for invitations and systematic contact with eligible women. The Tamil Nadu Health Systems Project is a long-standing breast and cervical cancer screening programme in the southern state of Tamil Nadu, India.⁵⁹ Financed by the state, the project entered into a contract with a leading information technology company (Tata Consultancy Service, Chennai), which developed a data collection and management system that allows for unique patient identifiers, data collection, and management of records, and that integrates patient laboratory data and allows screening managers to serve clients efficiently.⁶⁰

These examples from LMICs highlight opportunities to replicate and tailor successful models. However, challenges remain in high-resource and low-resource settings. In LMICs, the challenges are related to inequity in service delivery, poor adoption of recommendations, unavailability of trained pathologists to make accurate diagnoses, poor infrastructure and expertise in providing evidence-based treatment, shortfalls in finance for screening programmes, and population size and diversity.² Cancer screening programmes in large populations such as India pose unique challenges, including variations in cancer burden, cancer risk, and care delivery practices, and intracountry differences in cancer site prevalence, cancer policy, and financing. Other examples include recruitment of populations, and education about risks and benefits of screening for a disease that does not pose a health challenge at the time of screening. A considerable challenge to cancer screening in LMICs is the poor systems that are in place to link screening, diagnosis, and treatment.² Inadequate

cancer diagnosis and treatment expertise result in poor clinical management. Policies need to consider these diversities in cancer burden, risk, and management while making screening recommendations and investments.

In high-resource settings, similar challenges are experienced among population subgroups, such as rural residents, minority groups, indigenous tribes, and native populations.²⁷ LMIC approaches in the triage of patients from screening to treatment, strategies to reduce fear and stigma attributable to cancer, and the use of technologies to improve patient education and navigation through the health system might inform screening efforts in these subpopulations.

The lessons from these international experiences have informed the development of the operational guidelines for cancer screening in India. Estimates from India suggest that 1·4 million new cases of cancer occurred in 2012, a number that is projected to increase to 1·7 million by 2020.⁶¹ In view of India's huge and diverse population, implementation of a systematic cancer screening programme is a major challenge. The operational framework guidelines for cancer screening have been formulated with six specific objectives that collectively align with the recommendations of the ICSN.¹² The first objective is the organisation of referral and treatment services. This objective recognises the role of screening as a process and outlines the systems and infrastructure that need to be in place for referral and treatment of positive cancer screening results. The second objective of human resource requirements, and the third objective of a training strategy, comprehensively discuss how screening will be delivered, and by whom, within India's public health system. Clear guidelines and algorithms for screening service delivery are outlined and the role of various providers is outlined to help optimise patient outcomes in the care screening continuum. To emphasise community engagement, behaviour change communication that seeks to provide information and education about cancer prevention and control is outlined as the fourth objective. Programme monitoring and financing are the last two objectives. Programme monitoring will be done by national surveys. Although implementation science research is not specified in the guidelines, it was discussed in the meeting as a strategy to show and assess new approaches to deliver screening, and to gather data for programme delivery.

Panel 2 summarises international experiences by outlining salient features of screening implementation in accordance with the five essential elements. A cancer screening policy provides direction on screening eligibility and the types of recruitment needed. The financing of cancer screening, however, determines access to these services. When screening is implemented as part of an organised programme, predetermined and structured systems are in place to recruit participants by invitation letters or from individual practitioners.⁶² Furthermore, mechanisms are implemented to track women who tested positive from screening and to triage them to treatment,^{30,48} who are then in turn linked to help track incidence and outcomes. Screening programmes also invest heavily in health personnel and systems infrastructure. Training of screeners (general practitioners, nurses, community health workers) and physicians to use screening tools, provide accreditations, and offer screening and follow-up reminders are a routine part of organised programmes. Improvement strategies identified through implementation science research include testing the efficacy of invitational strategies, examining the integration of cancer screening with other public health clinic programmes (ie, HIV prevention and treatment), and assessing the

adoption of newer and context-appropriate methods of screening, such as self-collection of cervical swabs.^{43,53,54}

Panel 2

Essential elements in cancer screening adopted by different countries

Cancer screening policy

- Population to be screened
- Type of recruitment: organised vs opportunistic
- Type of financing of screening programme
- Screening as a process

Invitation systems for recruitment

- Algorithms on screening; triaging and referral for positive screens to treatment
- Linking screening data to population-based registries
- Data systems and resources invested to track patients who are screened to ensure return to screening or the completion of treatment as appropriate

Health systems infrastructure

- Trained screeners (general practitioners, nurses, community health workers)
- Physicians offer screening and screening reminder
- Systems to collect and read smears and send forward to analysis
- Management and supervisory structure to ensure operations of screening programme
- Stock of supplies and consumables for screening

Monitoring and assessment

- Establish frameworks for monitoring and assessment
- Periodic monitoring of programme to assess performance; from the use of data to improve screening delivery

Implementation science research

- Assessment of invitational strategies to screening programme
- Determination of age and screening intervals; identification of high-risk groups
- Identification of strategies to promote screening participation (understanding barriers and facilitators to screening participation)

Decision-making framework for cancer screening

Adoption of the essential elements of cancer screening in LMICs remains low, with a few exceptions. Discussions about country-specific experiences highlighted factors in need of consideration by decision makers before launching a screening programme. Several recommendations were noted. First, health systems need to consider and generate the scientific evidence needed for screening. Screening programmes are expensive and can drain resources rather quickly. Having an oversight structure at the national level that routinely assesses data from screening programmes and deliberates how implementation varies across different regional programmes is key.⁴⁷ For example, a national screening planning committee might facilitate informed decisions about the type of cancer to screen, or the best screening tests to use on the basis of test characteristics including cost and population acceptance. Furthermore, this step allows for discussions of the evidence and the need for pilot and demonstration projects that might help adapt intervention and assess feasibility of strategies in each country's unique context. Given the similarities between LMICs and underserved communities in high-income countries, with respect to poor access and affordability, low awareness, and cancer stigma, research in LMICs can generate evidence that might reduce cancer health disparities in communities worldwide.

Second, the type and readiness of health systems for the implementation of a screening programme should be considered. Publicly financed health systems facilitate access and affordability. In the absence of these publicly financed systems, LMICs might consider the use of existing resources and services for cancer screening. This approach includes training community-based workers for screening and for triage, a model that has been explored for screening in cervical cancer and is being considered for colorectal cancer screening;⁶³ integration of cancer screening into primary cancer and infectious disease clinics; and use of existing non-communicable disease programmes and maternal and child health services for education about cancer prevention and screening.

Third, monitoring and assessment should be adopted as a central philosophy and practice, as part of a screening programme's ambition. An assessment of the NBCCDP showed that on average about 10% of a screening programme's budget is devoted to monitoring and assessment.³⁴ This investment is a crucial one for policy makers to consider while promoting cancer screening. Data collection, its timely analysis, and its use for screening programme management is a routine part of long-standing screening programmes, and is a basis for programme improvements—actions that ultimately benefit the population in need of screening. Research in LMICs highlights innovative approaches that use technology, and efficient systems thinking and management, to optimise patient care at a low cost. Experiences from LMICs on screening programme monitoring and evaluation might offer lessons to similar programmes in other parts of the world.

And finally, expert consensus is needed before implementation. A wide body of guidance exists for cancer screening, such as WHO guidelines, recommendations from the US Preventive Services Task Force, and guidelines from other national screening programmes. Despite these guidelines, policy makers might believe a disconnect exists between these guidelines and the realities of their community or political leadership. Seeking international

consultation might therefore be an opportunity to learn from already established screening programmes and to gain ideas about decisions on implementation that have already been made. These consultations offer a chance to understand the push factors of scientific evidence, international guidance and experience, and the pull factors of national priorities and politics that are often made with good intent.⁶⁴ Consultations can also help understand country-specific efforts in the continuum of cancer control (eg, the future of cervical cancer screening among vaccinated women)⁶⁵ and offer operational advice such as integration into a larger health system.

Conclusion

Discussions at the ICSN meeting in Agartala highlighted key lessons learned from national cancer screening programmes and emphasised the many opportunities ahead for cancer screening in these settings. Regardless of income levels, countries around the world are identifying approaches to offer screening programmes to their residents via financing, community engagement, and strengthening of health-care systems. By recognising that screening is a step in the continuum of cancer care, governments can use available technologies and human resources to help detect cancers early and treat them successfully.

References

1. Torre LA, Bray F, Siegel RL, Ferlay J, Lortet-Tieulent J, Jemal A. Global Cancer Statistics, 2012. *CA Cancer J Clin.* 2015; 65:87–108. [PubMed: 25651787]
2. Farmer P, Frenk J, Knaul FM, et al. Expansion of cancer care and control in countries of low and middle income: a call to action. *Lancet.* 2010; 376:1186–93. [PubMed: 20709386]
3. Sloan, FA., Gelband, H. Institute of Medicine (US) Committee on Cancer Control in Low- and Middle-income Countries. Cancer control opportunities in low- and middle-income countries. Washington, DC: National Academies Press; 2007.
4. WHO. [accessed Oct 2, 2017] Cancer prevention and control in the context of an integrated approach: draft resolution proposed by Brazil, Canada, Colombia, Costa Rica, France, Netherlands, Nigeria, Panama, Peru, Russian Federation, Thailand and Zambia. May 25. 2017 http://apps.who.int/gb/ebwha/pdf_files/WHA70/A70_ACONF9-en.pdf?ua=1
5. Taplin SH, Anhang Price R, Edwards HM, et al. Introduction: understanding and influencing multilevel factors across the cancer care continuum. *J Natl Cancer Inst Monogr.* 2012; 2012:2–10. [PubMed: 22623590]
6. Mallath MK, Taylor DG, Badwe RA, et al. The growing burden of cancer in India: epidemiology and social context. *Lancet Oncol.* 2014; 15:e205–12. [PubMed: 24731885]
7. Sullivan, T., Sullivan, R., Ginsburg, OM. Screening for cancer: considerations for low- and middle-income countries. In: Gelband, H.Jha, P.Sankaranarayanan, R., Horton, S., editors. Cancer: disease control priorities. 3. Vol. 3. Washington, DC: The International Bank for Reconstruction and Development, The World Bank; 2015.
8. Lynge E, Tornberg S, von Karsa L, Segnan N, van Delden JJ. Determinants of successful implementation of population-based cancer screening programmes. *Eur J Cancer.* 2012; 48:743–48. [PubMed: 21788130]
9. Miles ACJ, Smith RA, Wardle J. A perspective from countries using organized screening programmes. *Cancer.* 2004; 101(5 suppl):1201–13. [PubMed: 15316915]
10. Eichholzer M, Richard A, Rohrmann S, et al. Breast cancer screening attendance in two Swiss regions dominated by opportunistic or organized screening. *BMC Health Serv Res.* 2016; 16:519. [PubMed: 27663642]

11. Cox B, Ballard-Barbash R, Broeders M, et al. Recording of hormone therapy and breast density in breast screening programs: summary and recommendations of the Screening Network. *Breast Cancer Res Treat.* 2010; 124:793–800. [PubMed: 20414718]
12. Ministry of Health and Family Welfare, Government of India. [accessed Oct 15, 2017] Operational framework management of common cancers. 2016. http://nicpr.res.in/images/pdf/Operational_Framework_Management_of_Common_Cancers.pdf
13. Bagcchi S. India launches plan for national cancer screening programme. *BMJ.* 2016; 355:i5574. [PubMed: 27754831]
14. Department of Health and Family Welfare, Government of Tripura, India. [accessed Oct 13, 2017] <http://health.tripura.gov.in/?q=about%20us>
15. Rajaraman P, Anderson BO, Basu P, et al. Recommendations for screening and early detection of common cancers in India. *Lancet Oncol.* 2015; 16:e352–61. [PubMed: 26149887]
16. Ballard-Barbash R, Klabunde C, Paci E, et al. Breast cancer screening in 21 countries: delivery of services, notification of results and outcomes ascertainment. *Eur J Cancer Prev.* 1999; 8:417–26. [PubMed: 10548397]
17. Anttila A, Lönnberg S, Ponti A, et al. Towards better implementation of cancer screening in Europe through improved monitoring and evaluation and greater engagement of cancer registries. *Eur J Cancer.* 2015; 51:1080–81.
18. von Wagner C, Baio G, Raine R, et al. Inequalities in participation in an organized national colorectal cancer screening programme: results from the first 2.6 million invitations in England. *Int J Epidemiol.* 2011; 40:712–18. [PubMed: 21330344]
19. Davies P, Valuta D, Cojohari N, Sancho-Garnier H. Implementing an organised cervical screening programme in the Republic of Moldova—stakeholder identification and engagement. *Cancer Epidemiol.* 2017; 50:272–77. [PubMed: 29120836]
20. Karsa, Lv, Anttila, A., Ronco, G., et al. [accessed Oct 3, 2017] Cancer screening in the European Union: report on the implementation of the council recommendation on cancer screening, first report. 2008. http://ec.europa.eu/health/archive/ph_determinants/genetics/documents/cancer_screening.pdf
21. WHO, World Economic Forum. [accessed Oct 13, 2017] From burden to “best buys”: reducing the economic impact of non-communicable diseases in low and middle income countries. 2011. http://www.who.int/nmh/publications/best_buys_summary.pdf
22. Global Burden of Disease Health Financing Collaborator Network. Evolution and patterns of global health financing 1995–2014: development assistance for health, and government, prepaid private, and out-of-pocket health spending in 184 countries. *Lancet.* 2017; 389:1981–2004. [PubMed: 28433256]
23. Chidyaonga-Maseko F, Chirwa ML, Muula AS. Underutilization of cervical cancer prevention services in low- and middle-income countries: a review of contributing factors. *Pan Afr Med J.* 2015; 21:231. [PubMed: 26523173]
24. Anhang Price R, Zapka J, Edwards H, Taplin SH. Organizational factors and the cancer screening process. *J Natl Cancer Inst Monogr.* 2010; 40:38–57.
25. WHO. [accessed Oct 3, 2017] Health systems. http://www.who.int/topics/health_systems/en/
26. Shastri SS, Mittra I, Mishra GA, et al. Effect of visual inspection with acetic acid (VIA) screening by primary health workers on cervical cancer mortality: a cluster randomized controlled trial in Mumbai, India. *J Natl Cancer Inst.* 2014; 106:dju009. [PubMed: 24563518]
27. Paskett ED, Krok-Schoen JL, Gray DM 2nd. Patient navigation— an effective strategy to reduce health care costs and improve health outcomes. *JAMA Oncol.* 2017; 3:825–26. [PubMed: 28125752]
28. Makariou-Pikis C, Peled AW, Newland GM, Wessel LA, Warren RD. Cultural sensitivity and health education: essential components to the success of the early detection cancer screening programme for Latinas at MedStar Georgetown University Hospital. *J Health Care Poor Underserved.* 2014; 25:460–68. [PubMed: 24858861]
29. Yano EM, Green LW, Glanz K, et al. Implementation and spread of interventions into the multilevel context of routine practice and policy: implications for the cancer care continuum. *J Natl Cancer Inst Monogr.* 2012; 2012:86–99. [PubMed: 22623601]

30. Lee NC, Wong FL, Jamison PM, et al. Implementation of the National Breast and Cervical Cancer Early Detection Programme: the beginning. *Cancer*. 2014; 120(suppl 16):2540–48. [PubMed: 25099896]
31. Perry N, Broeders M, de Wolf C, Tornberg S, Holland R, von Karsa L. European guidelines for quality assurance in breast cancer screening and diagnosis. Fourth edition–summary document. *Ann Oncol*. 2008; 19:614–22. [PubMed: 18024988]
32. Saraiya M, Irwin KL, Carlin L, et al. Cervical cancer screening and management practices among providers in the National Breast and Cervical Cancer Early Detection Programme (NBCCEDP). *Cancer*. 2007; 110:1024–32. [PubMed: 17628488]
33. Miller JW, Hanson V, Johnson GD, Royalty JE, Richardson LC. From cancer screening to treatment: service delivery and referral in the National Breast and Cervical Cancer Early Detection Programme. *Cancer*. 2014; 120(suppl 16):2549–56. [PubMed: 25099897]
34. Ekwueme DU, Subramanian S, Trogon JG, et al. Cost of services provided by the National Breast and Cervical Cancer Early Detection Programme. *Cancer*. 2014; 120(suppl 16):2604–11. [PubMed: 25099904]
35. Rees CJ, Bevan R. The National Health Service Bowel Cancer Screening Programme: the early years. *Expert Rev Gastroenterol Hepatol*. 2013; 7:421–37. [PubMed: 23899282]
36. Kovvali G. Colon cancer awareness for prevention: call for global initiatives. *J Carcinog*. 2009; 8:4. [PubMed: 19282577]
37. Travado L, Breitbart W, Grassi L, et al. 2015 President's Plenary International Psycho-oncology Society: psychosocial care as a human rights issue-challenges and opportunities. *Psychooncology*. 2017; 26:563–69. [PubMed: 27530206]
38. Palmer CK, Thomas MC, von Wagner C, Raine R. Reasons for non-uptake and subsequent participation in the NHS Bowel Cancer Screening Programme: a qualitative study. *Br J Cancer*. 2014; 110:1705–11. [PubMed: 24619071]
39. Meacham E, Orem J, Nakigudde G, Zujewski JA, Rao D. Exploring stigma as a barrier to cancer service engagement with breast cancer survivors in Kampala, Uganda. *Psychooncology*. 2016; 25:1206–11. [PubMed: 27421234]
40. Sivaram S, Sanchez MA, Rimer BK, Samet JM, Glasgow RE. Implementation science in cancer prevention and control: a framework for research and programs in low- and middle-income countries. *Cancer Epidemiol Biomarkers Prev*. 2014; 23:2273–84. [PubMed: 25178984]
41. Bradford L, Goodman A. Cervical cancer screening and prevention in low- resource settings. *Clin Obstet Gynecol*. 2013; 56:76–87. [PubMed: 23337844]
42. Campos NG, Maza M, Alfaro K, et al. The comparative and cost-effectiveness of HPV-based cervical cancer screening algorithms in El Salvador. *Int J Cancer*. 2015; 137:893–902. [PubMed: 25639903]
43. Arrossi S, Thouyaret L, Herrero R, et al. Effect of self-collection of HPV DNA offered by community health workers at home visits on uptake of screening for cervical cancer (the EMA study): a population-based cluster-randomised trial. *Lancet Glob Health*. 2015; 3:e85–94. [PubMed: 25617202]
44. Briant KJ, Espinoza N, Galvan A, et al. An innovative strategy to reach the underserved for colorectal cancer screening. *J Cancer Educ*. 2015; 30:237–43. [PubMed: 25002255]
45. van Ballegooijen M, Hermens R. Cervical cancer screening in the Netherlands. *Eur J Cancer*. 2000; 36:2244–46. [PubMed: 11072213]
46. Bigaard J, Hariri J, Lynge E. Cervical cancer screening in Denmark. *Eur J Cancer*. 2000; 36:2198–204. [PubMed: 11072204]
47. Anttila A, Lönnberg S, Ponti A, et al. Towards better implementation of cancer screening in Europe through improved monitoring and evaluation and greater engagement of cancer registries. *Eur J Cancer*. 2015; 51:241–51. [PubMed: 25483785]
48. Yancy B, Royalty JE, Marroulis S, Mattingly C, Benard VB, DeGross A. Using data to effectively manage a national screening program. *Cancer*. 2014; 120:2575–83. [PubMed: 25099900]
49. Ahmed T, Ashrafunnessa, Rahman J. Development of a visual inspection programme for cervical cancer prevention in Bangladesh. *Reprod Health Matters*. 2008; 16:78–85. [PubMed: 19027625]

50. Basu P, Nessa A, Majid M, Rahman JN, Ahmed T. Evaluation of the National Cervical Cancer Screening Programme of Bangladesh and the formulation of quality assurance guidelines. *J Fam Plann Reprod Health Care*. 2010; 36:131–34. [PubMed: 20659365]
51. de Silva A, Ranasinghe T, Abeykoon P. Universal health coverage and the health Sustainable Development Goal: achievements and challenges for Sri Lanka. *WHO South East Asia J Public Health*. 2016; 5:82–88. [PubMed: 28607233]
52. Knaul FM, González-Pier E, Gómez-Dantés O, et al. The quest for universal health coverage: achieving social protection for all in Mexico. *Lancet*. 2012; 380:1259–79. [PubMed: 22901864]
53. Tangcharoensathien V, Limwattananon S, Patcharanarumol W, Thammatacharee J. Monitoring and evaluating progress towards universal health coverage in Thailand. *PLoS Med*. 2014; 11:e1001726. [PubMed: 25243409]
54. Maza M, Alfaro K, Garai J, et al. Cervical cancer prevention in El Salvador (CAPE)—an HPV testing-based demonstration project: changing the secondary prevention paradigm in a lower middle-income country. *Gynecol Oncol Rep*. 2017; 20:58–61. [PubMed: 28337474]
55. Oluwole D, Kraemer J, Pink Ribbon Red R. Innovative public-private partnership: a diagonal approach to combating women's cancers in Africa. *Bull World Health Organ*. 2013; 91:691–96. [PubMed: 24101785]
56. Parham GP, Mwanahamuntu MH, Kapambwe S, et al. Population-level scale-up of cervical cancer prevention services in a low-resource setting: development, implementation, and evaluation of the cervical cancer prevention programme in Zambia. *PLoS One*. 2015; 10:e0122169. [PubMed: 25885821]
57. Randall TC, Ghebre R. Challenges in prevention and care delivery for women with cervical cancer in sub-Saharan Africa. *Front Oncol*. 2016; 6:160. [PubMed: 27446806]
58. Joshi R, Alim M, Kengne AP, et al. Task shifting for non-communicable disease management in low and middle income countries—a systematic review. *PLoS One*. 2014; 9:e103754. [PubMed: 25121789]
59. Department of Health and Family Welfare, Government of Tamil Nadu. [accessed Oct 12, 2017] Tamil Nadu Health Systems Project. Non-communicable disease prevention programme. Aug 15. 2016 <https://www.capam.org/files/2016IIApresentations/ScalingUpCervicalCancerScreening-India.pdf>
60. Tata Consulting Services. [accessed Oct 12, 2017] Ensuring equitable universal health services: TCS implements India's largest healthcare platform in Tamil Nadu. 2017. <https://www.tcs.com/tcs-implements-healthcare-platform-tamil-nadu>
61. Rath GK, Gandhi AK. National cancer control and registration program in India. *Indian J Med Paediatr Oncol*. 2014; 35:288–90. [PubMed: 25538407]
62. Jacobsen KK, von Euler Chelpin M, Vejborg I, Lynge E. Impact of invitation schemes on breast cancer screening coverage: a cohort study from Copenhagen, Denmark. *J Med Screen*. 2017; 24:20–26. [PubMed: 27206815]
63. Ruco A, Walsh CM, Cooper MA, Rabeneck L. Training non-physicians to do endoscopy: feasibility, effectiveness and cost-effectiveness. *Best Pract Res Clin Gastroenterol*. 2016; 30:389–96. [PubMed: 27345647]
64. Krishnan S, Sivaram S, Anderson BO, et al. Using implementation science to advance cancer prevention in India. *Asian Pac J Cancer Prev*. 2015; 16:3639–44. [PubMed: 25987015]
65. Lynge E, Antilla A, Arbyn M, Segnan N, Ronco G. What's next? Perspectives and future needs of cervical screening in Europe in the era of molecular testing and vaccination. *Eur J Cancer*. 2009; 45:2714–21. [PubMed: 19695870]

Search strategy and selection criteria

Although the paper summarises the discussions in the meeting, we conducted a PubMed search to support our statements and provide further background. We searched PubMed between Sept 10, 2016, and Oct 15, 2017. Only English language publications were included. We searched PubMed using the terms “cancer screening in low and middle income countries”, “universal health care and cancer screening”, “cost effectiveness in cancer screening”, “community health worker and cancer screening”. Articles identified through this search were then reviewed for content and citations.

Table

Key considerations for planners when monitoring and assessing cancer screening programmes

Components	
Minimum data elements	Data collection from high-risk population; proportion screened; proportion testing positive among those screened; proportion of test-positive individuals who complete follow-up and treatment
Performance and quality standards	Often quantitative limits of data elements that a programme attaches to minimum data elements— eg, >80% of all patients who screened positive will complete follow-up
Contextual influences	Understanding patient population (barriers and facilitators to participation); understanding providers' needs; identifying facility level factors that will improve patient satisfaction (sex of provider, waiting time); training and retraining to insure adherence to screening protocols
Data oversight standards	Data collection systems; data storage systems; data analysis (periodicity and procedures for feeding results to management); feedback systems to patients, providers, and other tiers of health system